U.S. PATENT APPLICATION

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Invention: ALLOCATION OF IP ADDRESS BY PROXY TO DEVICE IN A LOCAL
                 AREA NETWORK

SPECIFICATION

APPLICATION

FOR

UNITED STATES LETTERS PATENT

Be it known that we, Christopher John Buse, a citizen of Great Britain, residing at 126 Balmoral Road, Watford, Hertfordshire, WD2 4ET, England, Andrew Peter White, a citizen of Great Britain, residing at 6 Westbourne Mews, The Maltings, St Albans, Hertfordshire, AL1 1LS, England, David Kirby, a citizen of Great Britain, residing at 40 Kimpton Close, Hemel Hempstead, Hertfordshire, HP2 7PW, England, Robert Allsworth, a citizen of Great Britain, residing at 5 Soden Place, The Paddocks, Faringdon Road, Abingdon, Oxfordshire, OX13 5EY, England and David Eric Bill, a citizen of Great Britain, residing at 14 Beresford Road, St Albans, Hertfordshire, AL1 5NP, England have invented new and useful improvements in:

ALLOCATION OF IP ADDRESS BY PROXY TO DEVICE IN A LOCAL AREA NETWORK

of which the following is a specification:

ALLOCATION OF IP ADDRESS BY PROXY TO DEVICE IN A LOCAL AREA NETWORK

5 A1   Field of the Invention

This invention relates to packet-based data communication networks, particularly local area networks (LANs) and more particularly to the allocation of a protocol (IP) address to a device newly connected into the network.

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A2   Background to the Invention

When a new device is connected into an existing network, typically a local area network, it is desirable to determine whether such a device has a protocol address which is compatible with other devices on the network and to allocate the protocol address to the device if it does not already possess one. Another aspect of the process is the discovery of a device which does not have a protocol address on a network and to configure its protocol address in a convenient and compatible manner.

There are various schemes, such as dynamic host communication protocol (DHCP), and automatic private IP addressing, which can be used by a device to obtain a protocol address which is compatible with the network in which the device is to operate.

Ordinary network management discovery mechanisms generally rely on an existing configuration of devices for IP (internet protocol) and discover devices by performing a process known as ICMP Echo Request and Reply for all the IP addresses in a management station subnet. They presume that the user or network manager is knowledgeable.

Many devices have limited memory available for embedded software and are therefore not well adapted for direct participation in the programmed allocation of IP addresses.

A.3 Summary of the Invention

One aspect of the present invention is a discovery scheme which can be operated by a proxy device, such as a personal computer coupled to a local area network, and which facilitates the discovery of devices which may or may not be configured with an IP address.

Another aspect of the invention is a proxy scheme for the allocation of an IP address to a new unconfigured device discovered by the discovery mechanism.

Further objects and features will be apparent from the following description by way of example of a preferred scheme according to the invention.

A.4 Brief Description of the Drawings

Figure 1 illustrates in simplified form a local area network and some devices connected thereto.

Figure 2 schematically illustrates a discovery protocol.

Figure 3 illustrates the operation of an IP address allocation scheme which may be performed by a proxy in a system according to Figure 1.

Figure 4 is a table showing the organisation and sizes of fields within control packets which may be employed in the present invention.

Figure 5 is a table indicating the names and purposes of the fields within the control packets.

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Figure 1 illustrates a local area network 1, comprising a multiplicity of interconnected devices. Coupled to the network is a user terminal 2 which may, particularly if it is operating under a 'Windows' (registered trade mark) operating scheme, host a DHCP

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(dynamic host communication protocol) and also an automatic private IP addressing scheme. Reference numeral 3 denotes a PC coupled to the local area network and capable of operating the schemes described hereinafter.

5   Various allocation schemes may be used in networks of this general character. They are known as DHCP, automatic private IP addressing and the manual allocation of static addresses.

PCs that are configured to acquire an address by DHCP but fail to locate a DHCP server
10   may be able to allocate themselves an address at pseudo random from a particular subnet. If the PC supports DHCP but not the self allocation feature it will attempt to operate with no IP address if DHCP fails to allocate an address. In this instance the PC will operate as a local machine but not participate in the network. If the PC can allocate its IP address it then performs an address resolution protocol on the address to check for any conflict and
15   proceeds to use the allocated address.

Figure 2 illustrates the discovery protocol which may be performed by the proxy in relation to a new device. Figure 3 and 4 illustrate by way of example the control frames or packets that can be employed. The process employs three basic packets, distinguished by
20   different operating codes ('Op-codes'). The proxy will periodically send an interrogation, identified herein as a frame having the 'ARE_YOU_THERE?' op-code. Devices that see such an interrogation will respond with a reply, identified herein as a control frame having the 'I_AM_HERE' op-code. The device will return its MAC address (the third, 6-byte, field shown in Figures 4 and 5. Unconfigured devices will respond with an IP address
25   field set to a conventionally invalid value such a 0.0.0.0. Devices such as servers that have previously been configured will respond with an IP address field set to their IP address, completing the exchange. If desired or appropriate the device may return in the appropriate fields values for a subnet mask (set to an invalid value if the device is unconfigured), a default gateway (likewise set to an invalid value if the device is
30   unconfigured) and a lease time which can be used by a proxy to indicate that the address is obtained by DHCP and is time-limited. A particular conventional value is employed to represent an infinite lease time.

A response from a device with an unconfigured IP address will initiate a process for resolving an IP address. That process is described with reference to Figure 3 and in practice is mainly performed by software within the proxy 3.

When the proxy has resolved an IP address for the device it sends a declaratory message, identified herein as 'YOU_ARE' the message including the allocated IP address and preferably a subnet mask and other IP configuration parameters.

Upon receipt of the 'YOU_ARE' message frame the device will configure itself with the supplied parameters and respond with a 'I_AM_HERE' message frame, the IP address field being set to the new IP address allocated to that device. If the allocation mechanism were through DHCP, the device will use that IP address for as long as its lease time allows. It will revert to 0.0.0.0 when the 'lease' expires. Periodically, the proxy may update (or validate) the least be interaction with the DHCP server to gain refreshed lease parameters. A special case of the lease is 'infinite' where the IP address is used for as long as the device is operational.

As will be apparent, an advantage of such a scheme is that the functionality associated with operating an IP address allocation scheme such as DHCP can be migrated from the device to a proxy. In practice, this means that the device need only (for the purpose of address allocation) contain 'embedded' software sufficient to respond to the messages described previously. This requires minimal storage space in the device. New IP schemes require only an upgrade to an application which runs on the PC and will not normally require an upgrade of the devices. Furthermore, the scheme will operate over networks. It can be used to hide the MAC address from the user. The MAC address is used by the proxy to uniquely identify a device so that the device is not confused with other devices. If an IP address needs (as described later) to be entered by the user, the user is prompted to supply merely an IP address; there is no need to specify the MAC address because this is handled internally by the proxy.

Figure 3 illustrates a scheme by which the IP address may be allocated to an unconfigured device newly discovered on the network. The stages shown in Figure 3 are all performed by the proxy device 3 on behalf of the 'new' device 4.

Stage 31 indicates the discovery of a new unconfigured device. This corresponds to the receipt of the 'I_AM_HERE' message with the dummy IP address as described with reference to Figure 2. The proxy 3 now sends a DHCP request on behalf of the device 4. If there is a DHCP server on the network, the proxy 3 will receive a DHCP response with an IIP address for the device. The proxy can then send out a YOU_ARE frame configuring the device 4 with this IP address – stage 34. If the proxy does not receive a response to the DHCP request then it will timeout and move on to stage 35. If there is a time-out, there is a determination whether proxy's address is in the automatic private IP range. For the proxy to allocate IP addresses to devices using Automatic Private IP addressing, its own address must also be in this range. If its address is not in this range and the device is allocated an IP address from the auto IP range then the proxy will not be able to communicate with the device using IP as they will be in separate subnets. If it is in that range, an IP address may be automatically allocated, stage 36, the address may be tested for conflict with any existing addresses (stage 37). This may be done by means of an address resolution protocol (ARP) or an ICMP echo request. If there is a conflict, i.e. with an existing occupied address (stage 38) this sub process (stages 36 – 38) is repeated. Every time stage 36 is entered a new address is generated from the auto IP range for testing in stage 37. This cycle will continue until a free address is found. These three stages are all defined by an automatic private IP addressing scheme. If the proxy's address is not in an automatic private IP range, the user is prompted to provide an IP address, stage 39. On entry of the address the proxy checks whether the address is on the same subnet (stage 40). If necessary the manually entered IP address is conveyed to the device, stage 34.